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Solution by GEORGE W. HARTWELL, Columbia University, New York.

Dividing by x, $\dfrac{\partial^2 y}{\partial x^2}+\dfrac{2}{x}\dfrac{\partial y}{\partial x}-y=0\ldots(1)$.

Remove the term containing $\dfrac{\partial y}{\partial x}$ by substituting $y=\dfrac{v}{x}$. Then (1) becomes $\dfrac{\partial^2 v}{\partial x^2}-v=0\ldots(2)$.

The solution of this equation is $v=c_1e^x+c_2e^{-x}$. $\therefore xy=(c_1e^x+c_2e^{-x})$.

Solved in a similar manner by G. B. M. Zerr.

248. Proposed by REV. R. D. CARMICHAEL, Anniston, Ala.

Evaluate $\int_0^{\frac{1}{2}\pi}\sin nx\cot x dx$, where n is a positive integer.

Solution by G. B. M. ZERR, A. M., Ph. D., 4243 Girard Avenue, Philadelphia, Pa.

$$A=\int_0^{\frac{1}{2}\pi}\sin nx\ \cot x\ dx=\int_0^{\frac{1}{2}\pi}\frac{\sin(n-1)xdx}{\sin x}+\int_0^{\frac{1}{2}\pi}\cos nx\ dx$$

$$=2\int_0^{\frac{1}{2}\pi}[\cos x+\cos 3x+\cos 5x+\ldots+\cos(n-3)x]dx+\int_0^{\frac{1}{2}\pi}\cos nx\ dx$$

$$=2\left[\sin x+\tfrac{1}{3}\sin 3x+\tfrac{1}{5}\sin 5x+\ldots+\frac{1}{n-3}\sin\,(n-3)\,x\right]_0^{\frac{1}{2}\pi}+\frac{1}{n}\cos\frac{\pi n}{2}$$

$$=2\left[1-\tfrac{1}{3}+\tfrac{1}{5}-\tfrac{1}{7}+\tfrac{1}{9}-\ldots\pm\frac{1}{n-3}\right]\pm\frac{1}{n};\text{ for } n \text{ even}=\tfrac{1}{2}\pi \text{ if } n=\infty.$$

$$A=\int_0^{\frac{1}{2}\pi}[1+2\cos 2x+2\cos 4x+2\cos 6x+\ldots+2\cos(n-3)x]dx$$

$$+\int_0^{\frac{1}{2}\pi}\cos nx\ dx=\left[x+\sin 2x+\tfrac{1}{2}\sin 4x+\tfrac{1}{3}\sin 6x+\ldots+\frac{2}{n-3}\sin(n-3)x\right]_0^{\frac{1}{2}\pi}$$

$$+\frac{1}{n}\cos\frac{\pi n}{2}=\tfrac{1}{2}\pi,\text{ for } n \text{ odd.}$$

249. Proposed by G. B. M. ZERR, A. M., Ph. D., 4243 Girard Avenue, Philadelphia, Pa.

Ike, running with constant velocity v, is trying to catch Jim, running with constant velocity V, $(V>v)$, by keeping Jim dead ahead of him. Find their paths.

Solution by the PROPOSER.

Let I, J be the positions of Ike and Jim at the start; L, M their respective positions at any subsequent time t.

Let m, n be the coordinates of L; p, q the coordinates of M; ϕ the angle LM makes with IJ, $a=IJ$.

Then $dm/dt=v\cos\phi$, $dn/dt=v\sin\phi$, $p=m+a\cos\phi$, $q=n+a\sin\phi$.

$V^2=(dp/dt)^2+(dq/dt)^2$

$=(dm/dt-a\sin\phi\, d\phi/dt)^2+(dn/dt+a\cos\phi\, d\phi/dt)^2$

$=(v\cos\phi-a\sin\phi\, d\phi/dt)^2+(v\sin\phi+a\cos\phi\, d\phi/dt)^2$

$=v^2+a^2(d\phi/dt)^2$; $\therefore d\phi/dt=\surd(V^2-v^2)/a=b$.

$\therefore \phi=bt$, since $\phi=0$, when $t=0$.

$\therefore dm/dt=v\cos bt$, where $b=\surd(V^2-v^2)/a$.

$\therefore m=-\dfrac{v}{b}\sin bt$, $n=\dfrac{v}{b}(\cos bt-1)$. Therefore, Ike describes a circle.

Also, $p=a\cos bt-(v/b)\sin bt$, $q=a\sin bt+(v/b)(\cos bt-1)$.

Therefore, Jim also describes a circle.

MECHANICS.

191. Proposed by DR. L. E. DICKSON, The University of Chicago.

Give the axiomatic principle of Physics which is equivalent to the theorem on the compound of two circles ("Graphical Methods in Trigonometry," MONTHLY, June-July, 1905).

Solution by G. B. M. ZERR, A. M., Ph. D., 4243 Girard Avenue, Philadelphia, Pa.

There are two principles that might be considered equivalent to the theorem on the compound of two circles. First, the parallelogram of velocities; second, the parallelogram of forces.

These might be named the compound of two velocities and the compound of two forces. We can state both under one theorem as follows:

The compound of a $\left\{\begin{matrix}\text{velocity}\\ \text{force}\end{matrix}\right\}$ OP with a $\left\{\begin{matrix}\text{velocity}\\ \text{force}\end{matrix}\right\}$ OR is the diagonal OQ of the parallelogram $OPQR$.

The proof by vectors follows at once. Regarding OP, OR, OQ as vectors we get at once $OP+OR=OQ$.

207. Proposed by W. J. GREENSTREET, M. A., Marling School, Stroud, England.

A portion of a parabola is bounded by the curve, the axis and an ordinate. A circle is inscribed to the figure which is regarded as a plane lamina. The area of the inscribed circle is now punched out. Find the centroid of what is left.

Solution by G. B. M. ZERR, A. M., Ph. D., 4243 Girard Avenue, Philahelphia, Pa.

Let $y^2=4ax$ be the parabola, b the abscissa of the portion considered,